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SURFACE VEHICLE STANDARD

SAE J2244/2 (ISO 6149-2)

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Submitted for recognition as an American National Standard

CONNECTIONS FOR FLUID POWER AND GENERAL USE— PORTS AND STUD ENDS WITH ISO 261 THREADS AND O-RING SEALING PART 2: HEAVY-DUTY (S SERIES) STUD ENDS— DIMENSIONS, DESIGN, TEST METHODS, AND REQUIREMENTS

This document is technically equivalent to ISO 6149-2, except as noted in the Foreword.

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board format.

SAE J2244 parts 1 and 2 were prepared by SAE FCCTC-SC1, Automotive and Hydraulic Tube and Fitting Subcommittee and ISO/TC 131, Fluid power systems. SAE J2244 consists of the following parts under the general title: Connections for Fluid Power and General Use—Ports and Stud Ends with ISO 261 Threads and O-ring Sealing—

Part 1: Port with O-ring Seal in Truncated Housing

Part 2: Heavy-duty (S series) Stud Ends—Dimensions, Design, Test Methods, and Requirements

The two parts of SAE J2244 constitute a revision of ISO 6149:1980. This revision defines performance requirements, dimensions, and designs for port and heavy-duty (S series) stud ends. Significant testing was conducted to confirm the performance requirements of stud ends made from carbon steel. ISO 6149-2 applies to fittings detailed in ISO 8434 parts 1, 3, and 4.

SAE J2244 Parts 1 and 2 are technically equivalent to ISO 6149 parts 1 and 2, respectively. Parts produced to either standard will interchange with parts produced to the other standard. **Two main differences exist between the SAE standards and the ISO standards: size M30 x 2 is included in SAE standard but not in the ISO standard and the tube ODs have been shown in the SAE standard for the port sizes.** The SAE subcommittee chose not to include ISO 6149-3, a light-duty stud end, within SAE J2244 to minimize part proliferation.

Appendix A of this standard is normative.

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. In general applications, a fluid may be conveyed under pressure. Components are connected through their threaded ports by stud ends on fluid conductor fittings to tubes and pipes, or to hose fittings and hoses.

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1. ***Scope—***This part of SAE J2244 specifies dimensions, performance requirements, and test procedures for metric adjustable and nonadjustable heavy-duty (S series) stud ends and O-rings.

Stud ends in accordance with this part of SAE J2244 may be used at working pressures up to 63 MPa for nonadjustable stud ends and 40 MPa for adjustable stud ends. The permissible working pressure depends upon materials, design, working conditions, application, etc.

For threaded ports and stud ends for use in new designs in hydraulic fluid power applications, only SAE J2244 shall be used. Threaded ports and stud ends in accordance with ISO 1179, ISO 9974, and SAE J1926 (ISO 11926) shall not be used for new designs in hydraulic fluid power applications.

Conformance to the dimensional information in this standard does not guarantee rated performance. Each manufacturer shall perform testing according to the specification contained in this standard to ensure that components made to this standard comply with the performance ratings.

2. ***References***

2.1 **Applicable Publications—**The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated as follows. Members of IEC and ISO maintain registers of currently valid International Standards.

2.1.1 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 48:1979—Vulcanized rubbers—Determination of hardness (Hardness between 30 and 85 IRHD)
ISO 261:1973—ISO general purpose metric screw threads—General plan
ISO 1179-1:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 228-1 threads with elastomeric and metal-to-metal sealing—Part 1: Threaded port
ISO 1179-2:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 228-1 threads with elastomeric and metal-to-metal sealing—Part 2: Heavy duty (S series) and light duty (L series) stud ends with elastomeric sealing (type E)
ISO 1179-3:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 228-1 threads with elastomeric and metal-to-metal sealing—Part 3: Light duty (L series) stud ends with sealing by O-ring with retaining ring (types G and H)
ISO 1179-4:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 228-1 threads with elastomeric and metal-to-metal sealing—Part 4: Stud end for general use only with metal-to-metal sealing (type B)
ISO 1302:1978—Technical drawings—Method of indicating surface texture on drawings
ISO 3448:1975—Industrial liquid lubricants—ISO viscosity classification
ISO 3601-3:1987—Fluid systems—Sealing devices—O-rings—Part 3: Quality acceptance criteria
ISO 4759-1:1978—Tolerances for fasteners—Part 1: Bolts, screws and nuts with thread diameters between 1.6 (inclusive) and 150 mm (inclusive) and product grades A, B and C
ISO 5598:1985—Fluid power systems and components—Vocabulary
ISO 6149-1:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 261 threads and O-ring sealing—Part 1: Port with O-ring seal in truncated housing
ISO 6149-2:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 261 threads and O-ring sealing—Part 2: Heavy duty (S series) stud ends—Dimensions, design, test methods and requirements
ISO 6149-3:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 261 threads and O-ring sealing—Part 3: Light duty (L series) stud ends—Dimensions, design, test methods and requirements

1. To be published.

ISO 6803:1984—Rubber or plastic hoses and hose assemblies—Hydraulic pressure impulse test without flexing
ISO 7789:-[1]—Hydraulic fluid power—Two, three- and four-port screw-in cartridge valve cavities
ISO 9974-1:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 261 threads and elastomeric sealing ring and metal-to-metal sealing—Part 1: Threaded port
ISO 9974-2:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 261 threads and elastomeric sealing ring and metal-to-metal sealing—Part 2: Stud end with elastomeric sealing (type E)
ISO 9974-3:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 261 threads and elastomeric sealing ring and metal-to-metal sealing—Part 3: Stud end with metal-to-metal sealing (type S)
ISO 11926-1:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 725 threads and O-ring sealing—Part 1: Threaded port
ISO 11926-2:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 725 threads and O-ring sealing—Part 2: Heavy duty (S series) stud end
ISO 11926-3:-[1]—Connections for fluid power and general use—Ports and stud ends with ISO 725 threads and O-ring sealing—Part 3: Light duty (L series) stud end

2.2 Other Publications—U.S. References Identical to ISO References

2.2.1 ANSI PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI/ASME B1.13M—83, Metric Screw Threads—M Profile

2.2.2 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J343 APR91—Test and Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies
SAE J1926 AUG88—Specifications for Straight Thread O-ring Boss Port
SAE J2244/1/ISO 6149-1:DEC91—Connections for Fluid Power and General Use—Ports and Stud Ends With ISO 261 Threads and O-ring Sealing—Part 1: Port With O-ring Seal in Truncated Housing

3. Definitions—For the purposes of this part of SAE J2244, the definitions given in ISO 5598 and the following definitions shall apply:

3.1 Adjustable Stud End—A stud end that allows for orientation before final tightening of the connection.

3.2 Nonadjustable Stud End—A stud end that does not allow for orientation before final tightening of the connection.

4. Stud End Size—The stud ends shall be specified by SAE J2244/2 and the thread size, separated by a colon, for example, SAE J2244/2:M18 x 1.5.

5. Requirements

5.1 Dimensions—Heavy-duty (S series) stud ends shall conform to the dimensions given in Figures 1A and 1B and Table 1. Hex tolerances across flats shall be according to ISO 4759-1, product grade C.

5.2 Working Pressure—Heavy-duty (S series) stud ends made of carbon steel shall be designed for use at the working pressures given in Table 2.

5.3 Performance—Heavy-duty (S series) stud ends made of carbon steel shall meet or exceed the burst and impulse pressures given in Table 2, when tested according to Section 7.

1. To be published

5.4 Identification—Heavy-duty (S series) stud ends shall be identified according to the detail shown in Figures 1A and 1B and the dimensions given in Table 1. Nonadjustable (straight) stud ends shall be identified by a turn diameter, d_2, and a notch on the turn diameter. Adjustable stud ends shall be identified by only a turn diameter, d_2, on the locknut. In addition to this identification, for both the nonadjustable and adjustable stud ends, the manufacturer may mark the stud end with the word "metric."

5.5 Adjustable Stud End Washer Fit and Flatness—The washer shall be clinched to the stud end with a tight slip fit to an interference fit. The slip fit shall be tight enough so that the washer cannot be shaken loose to cause it to drop from its uppermost position by its own weight. The locknut torque needed to move the washer at the maximum washer interference fit shall not exceed the torques given in Table 3.

Any washer surface that is out of flatness shall be uniform (i.e., not wavy) and concave with respect to the stud end and shall conform to the allowance given in Table 3.

6. O-rings—O-rings for use with heavy-duty (S series) stud ends shall conform to the dimensions given in Figure 2 and Table 4.

7. Test Methods

NOTE—Parts used for cyclic endurance or burst test shall not be tested further, used, or returned to stock.

7.1 Burst Pressure Test

7.1.1 PRINCIPLE—Three samples of both adjustable and nonadjustable shall be tested to confirm that heavy-duty (S series) stud ends meet or exceed a ratio of 4:1 between the burst and working pressures.

7.1.2 MATERIALS

7.1.2.1 Test Block and Stud Ends—Test blocks shall be unplated and hardened to 45-55 HRC. Stud ends shall be made from carbon steel and plated.

7.1.2.2 Test O-rings—Unless otherwise specified, O-rings shall be made from nitrile (NBR) rubber with a hardness of 85 +10/-0 IRHD when measured per ISO 48. O-rings shall conform to the dimensions given in Table 4 and shall meet or exceed the quality requirement grade N in ISO 3601-3.

7.1.3 PROCEDURES

7.1.3.1 Thread Lubrication—For testing only, threads and contact surfaces shall be lubricated with hydraulic oil with a viscosity of VG 32 per ISO 3448 prior to the application of torque.

7.1.3.2 Stud End Torque—Stud ends shall be tested after application of the torques given in Table 5. Adjustable stud lockout torques shall be applied after the stud end has been backed out one full turn from finger tight position, to correctly test the worst possible actual assembly conditions.

7.1.3.3 Pressure Rise Rate—During the burst test, the rate of pressure rise shall not exceed 138 MPa per minute.

7.1.4 TEST REPORT—Test results and conditions shall be reported on the test data form in Appendix A.

7.2 Cyclic Endurance (Impulse) Test

7.2.1 PRINCIPLE—Six samples of both adjustable and nonadjustable stud ends, when tested at their respective impulse pressures, shall pass a cyclic endurance test of 1 000 000 cycles.

7.2.2 MATERIALS—Use the same materials as per 7.1.2.

7.2.3 PROCEDURES

7.2.3.1 *Thread Lubrication*—Apply lubricant per 7.1.3.1.

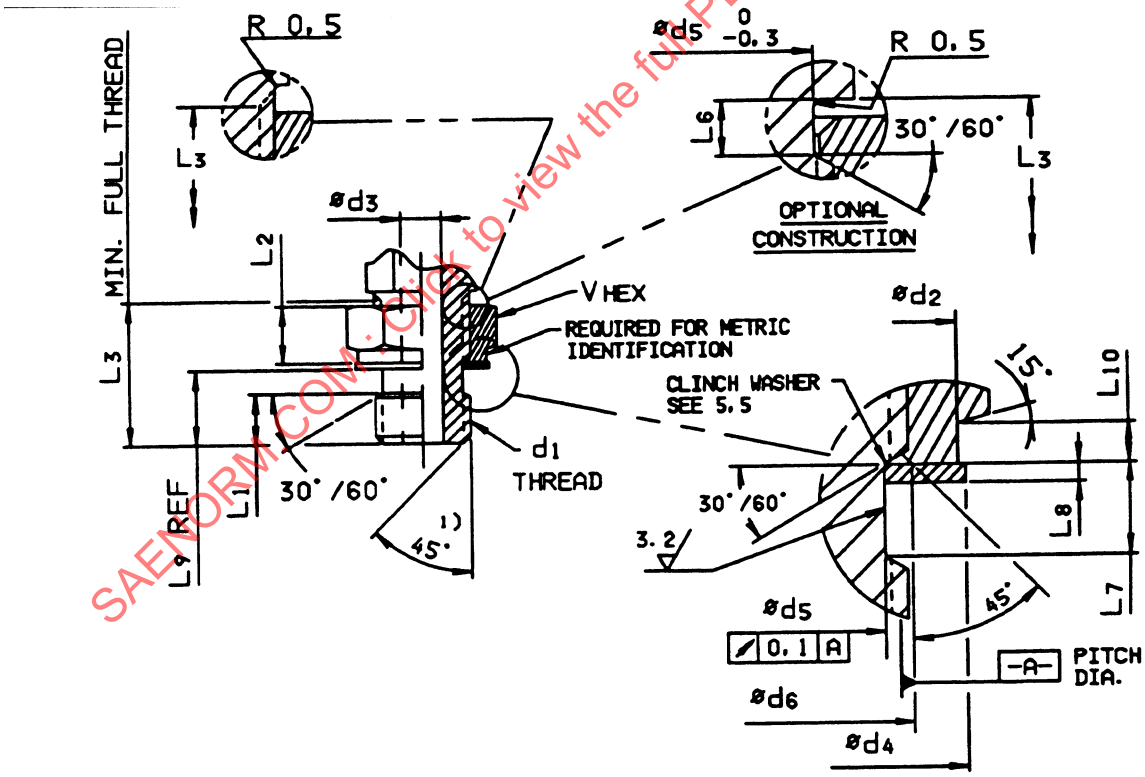
7.2.3.2 *Stud End Torques*—Apply torque per 7.1.3.2.

7.2.3.3 *Cycle and Pressure Rise Rate*—Cycle rate shall be uniform at 0.5 to 1.3 Hz and shall conform to the wave pattern shown in SAE J343 (ISO 6803).

7.2.4 TEST REPORT—Test results and conditions shall be reported on the test data form in Appendix A.

8. ***Identification Statement—***Use the following statement, except for M30 x 2,[1] in test reports, catalogues, and sales literature when electing to comply with this part of SAE J2244 (ISO 6149-2): Heavy-duty (S series) stud end conforms to SAE J2244/2 (ISO 6149-2), Connections for Fluid Power and General Use—Ports and Stud Ends with ISO 261 Threads and O-ring Sealing—Part 2: Heavy-duty (S series) Stud Ends—Dimensions, Design, Test Methods, and Requirements.

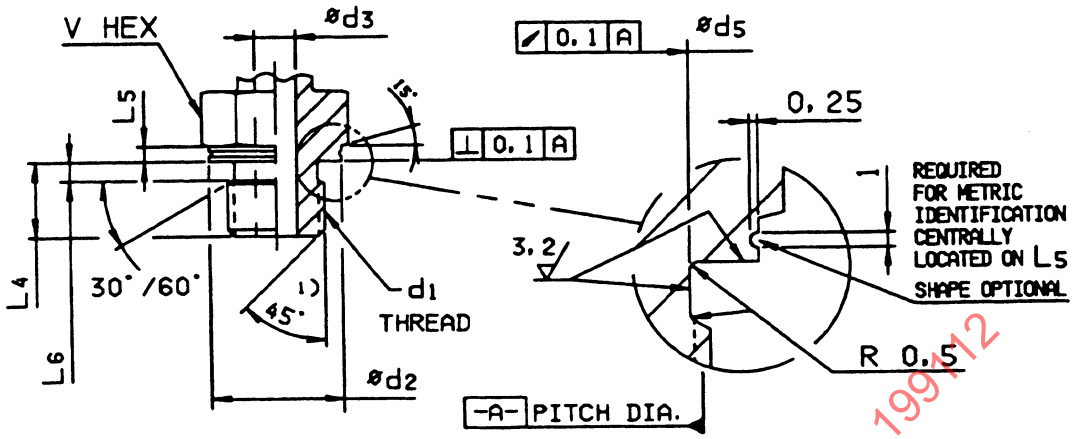
9. ***Key Words—***fluid power, pipe fittings, standard connection, standard coupling, pipe joints, ports, stud ends, specifications, design, operating requirements, dimensions, designation, test methods, metric, straight thread, O-ring seal, high pressure



1) Chamfer to minor diameter of threads

FIGURE 1A—ADJUSTABLE SAE J2244/2 HEAVY-DUTY (S SERIES) STUD END DETAIL

1. Not included in ISO 6149.



1) Chamfer to minor diameter of threads

FIGURE 1B—NONADJUSTABLE SAE J2244/2 HEAVY-DUTY (S SERIES) STUD END DETAIL

TABLE 1—SAE J2244/2—HEAVY-DUTY (S SERIES) STUD AND DIMENSIONS

Dimensions in Millimeters

Tube OD	Inch Nominal Tube Dash Size	Inch Nominal Tube OD mm	Inch Nominal Tube OD in	d_1[1]	d_2 ±0.2	d_3	d_4 ±0.4	d_5 0 −0.1	d_6 +0.4 0	L_1 ±0.2	L_2 ±0.2	L_3 Min	L_4 ±0.2	L_5 ±0.1	L_6 ±0.3 0	L_7 ±0.1	L_8 ±0.08 0	L_9 Ref.	L_{10} ±0.1	V Hex
4	–2	3.18	0.125	M8 x 1	11.8	2 + 0.14/0	12.5	6.4	8.1	6.5	7	18	9.5	2.5	2	4	0.9	9.6	1.5	12
5	–3	4.76	0.188	M10 x 1	13.8	3 + 0.14/0	14.5	8.4	10.1	6.5	7	18	9.5	2.5	2	4	0.9	9.6	1.5	14
6	–4	6.35	0.250	M12 x 1.5	16.8	4 + 0.18/0	17.5	9.7	12.1	7.5	8.5	21	11	2.5	3	4.5	0.9	11.1	2	17
8	–5	7.94	0.312	M14 x 1.5[2]	18.8	6 + 0.18/0	19.5	11.7	14.1	7.5	8.5	21	11	2.5	3	4.5	0.9	11.1	2	19
10	–6	9.52	0.375	M16 x 1.5	21.8	7 + 0.22/0	22.5	13.7	16.1	9	9	23	12.5	2.5	3	4.5	0.9	12.6	2	22
12	–8	12.7	0.500	M18 x 1.5	23.8	9 + 0.22/0	24.5	15.7	18.1	10.5	10.5	26	14	2.5	3	4.5	0.9	14.1	2.5	24
16	–10	15.88	0.625	M22 x 1.5	26.8	12 + 0.27/0	27.5	19.7	22.1	11	11	27.5	15	2.5	3	5	1.25	14.8	2.5	27
20	–12	19.05	0.750	M27 x 2	31.8	15 + 0.27/0	32.5	24	27.1	13.5	13.5	33.5	18.5	2.5	4	6	1.25	18.3	2.5	32
22	–14	22.22	0.875	M30 x 2[3]	35.8	18 + 0.33/0	36.5	27	30.1	13.5	13.5	33.5	18.5	2.5	4	6	1.25	18.3	2.5	36
25	–16	25.4	1.000	M33 x 2	40.8	20 + 0.33/0	41.5	30	33.1	13.5	13.5	33.5	18.5	3	4	6	1.25	18.3	3	41
30	–20	31.75	1.250	M42 x 2	49.8	26 + 0.33/0	50.5	39	42.1	14	14	34.5	19	3	4	6	1.25	18.8	3	50
38	–24	38.10	1.500	M48 x 2	54.8	32 + 0.39/0	55.5	45	48.1	16.5	15	38	21.5	3	4	6	1.25	21.3	3	55
50	–32	50.80	2.000	M60 x 2	64.8	40 + 0.39/0	65.5	57	60.1	19	17	42.5	24	3	4	6	1.25	23.8	3	65
				M20 x 1.5[4]	26.8			17.7					14	2.5	3				2.5	

1. Thread Class 6 g per ISO 261.
2. Preferred for diagnostic port applications.
3. Not included in ISO 6149.
4. For plug for cartridge cavity only. (See ISO 7789.)

TABLE 2—SAE J2244/2 HEAVY-DUTY (S SERIES) STUD END PRESSURE[1]

Units in Megapascals[2]

Tube OD	Thread Size	Stud End Style Nonadjustable Working[1] Pressure	Stud End Style Nonadjustable Test Pressure Burst	Stud End Style Nonadjustable Test Pressure Impulse[3]	Stud End Style Adjustable Working[1] Pressure	Stud End Style Adjustable Test Pressure Burst	Stud End Style Adjustable Test Pressure Impulse[3]
4	M8 x 1	63	252	83.8	40	160	53.2
5	M10 x 1	63	252	83.8	40	160	53.2
6	M12 x 1.5	63	252	83.8	40	160	53.2
8	M14 x 1.5	63	252	83.8	40	160	53.2
10	M16 x 1.5	63	252	83.8	40	160	53.2
12	M18 x 1.5	63	252	83.8	40	160	53.2
16	M22 x 1.5	63	252	83.8	40	160	53.2
20	M27 x 2	40	160	53.2	40	160	53.2
22	M30 x 2	40	160	53.2	40	160	53.2
25	M33 x 2	40	160	53.2	31.5	126	41.9
30	M42 x 2	25	100	33.2	25	100	33.2
38	M48 x 2	25	100	33.2	20	80	26.6
50	M60 x 2	25	100	33.2	16	64	21.3
For plug for cartridge valve cavity only (See ISO 7789)							
	M20 x 1.5	40	160	53.2	—	—	—

1. These pressures were established using fittings made of carbon steel when tested in accordance with Section 7.
2. To convert from MPa to bar multiply by 10. (10 bar/MPa)
3. Cyclic endurance test pressure.

TABLE 3—ADJUSTABLE STUD END WASHER TORQUE AND FLATNESS ALLOWANCE

Thread Size	Maximum Nut Torque to Move Washer N·m	Maximum Washer Flatness Allowance mm
M8 x 1	1	0.25
M10 x 1	3	0.25
M12 x 1.5	4	0.25
M14 x 1.5	5	0.25
M16 x 1.5	7	0.25
M18 x 1.5	10	0.25
M22 x 1.5	12	0.25
M27 x 2	15	0.40
M30 x 2	18	0.40
M33 x 2	20	0.40
M42 x 2	25	0.50
M48 x 2	30	0.50
M60 x 2	40	0.50

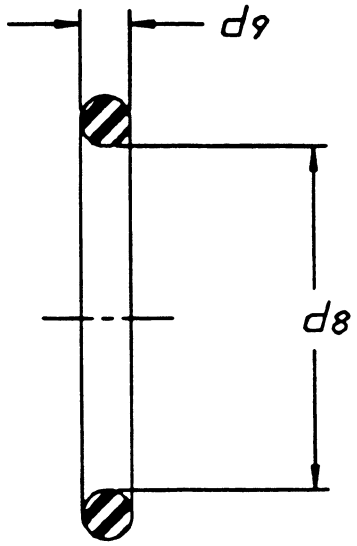


FIGURE 2—O-RING DETAIL

TABLE 4—SAE J2244/2 STUD END O-RING DIMENSIONS

Dimensions in Millimeters

Thread Size	Inside Diameter d_8	Inside Diameter d_8 tol. ±	Cross Section Diameter d_9	Cross Section Diameter d_9 tol ±
M8 x 1	6.1	0.20	1.6	0.08
M10 x 1	8.1	0.20	1.6	0.08
M12 x 1.5	9.3	0.20	2.2	0.08
M14 x 1.5	11.3	0.20	2.2	0.08
M16 x 1.5	13.3	0.20	2.2	0.08
M18 x 1.5	15.3	0.20	2.2	0.08
M22 x 1.5	19.3	0.22	2.2	0.08
M27 x 2	23.6	0.24	2.9	0.09
M30 x 2(1)	26.6	0.26	2.9	0.09
M33 x 2	29.6	0.29	2.9	0.09
M42 x 2	38.6	0.37	2.9	0.09
M48 x 2	44.6	0.43	2.9	0.09
M60 x 2	56.6	0.51	2.9	0.09
M20 x 1.5(2)	17.3	0.22	2.2	0.08

1. Not included in ISO 6149.
2. For plug for cartridge valve cavity only. (See ISO 7789.)

TABLE 5—TORQUE REQUIREMENTS FOR STUD END QUALIFICATION TEST

Thread Size	Torque +10% N·m –0
M8 x 1	10
M10 x 1	20
M12 x 1.5	35
M14 x 1.5	45
M16 x 1.5	55
M18 x 1.5	70
M22 x 1.5	100
M27 x 2	170
M30 x 2	215
M33 x 2	310
M42 x 2	330
M48 x 2	420
M60 x 2	500
M20 x 1.5(1)	80

1. For plug for cartridge valve cavity only. (See ISO 7789.)

PREPARED BY THE SAE FLUID CONDUCTORS AND CONNECTORS TECHNICAL COMMITTEE SC1—AUTOMOTIVE AND HYDRAULIC TUBE AND FITTING

APPENDIX A

(Normative)

A.1 See Figure A1.

SAE J2244/2 PORT AND STUD END TEST DATA FORM

Stud end specification:

Manufacturer _____ Test Facility _____

Stud End Type _____ Size _____

Minimum Material Tensile Strength _____ MPa

Stud End Working Pressure (Table 2) _____ MPa

Stud End Impulse Test Pressure (Table 2) _____ MPa

Stud End Burst Test Pressure (Table 2) _____ MPa

Qualification Test Assembly Torque (Table 3) _____ N·m

Burst Test Results: (Three samples minimum burst tested)

Sample No.	Pressure @ Failure	Torque	Hardness	Type of Failure
1. _____	_____ MPa	_____ N·m	_____	_____
2. _____	_____ MPa	_____ N·m	_____	_____
3. _____	_____ MPa	_____ N·m	_____	_____

Cyclic endurance test results: (Six samples minimum impulse tested)

Sample No.	Cycles @ Failure	Torque	Hardness	Type of Failure
1. _____	_____	_____ N·m	_____	_____
2. _____	_____	_____ N·m	_____	_____
3. _____	_____	_____ N·m	_____	_____
4. _____	_____	_____ N·m	_____	_____
5. _____	_____	_____ N·m	_____	_____
6. _____	_____	_____ N·m	_____	_____

Conclusions: Pass/fail and why- _____

_____

Dimensions/ List any exception: _____

_____

_____

Name (printed/typed) and signature of person certifying report:

_____ Date: _____

FIGURE A1—SAE J2244/2 PORT AND STUD END TEST DATA FORM